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27 June 2019

Federal Communications Commission
Ms. Marlene H. Dortch, Secretary
445 12th Street, S.W.
Washington, D.C. 20554

RE: Reply Comments for WT Docket No. 19-116

Ms. Dortch:

The Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison desires to inform the record on the importance of maintaining a reliable satellite broadcast of weather imagery for detecting and relying information on environmental hazards. SSEC is positioned to inform the record based on its longstanding and recognized past as a repository for weather satellite imagery, the birthplace of satellite meteorology, and a leader in satellite meteorology science, engineering, and related disciplines.

SSEC wholly endorses the joint filing from the American Geophysical Union (AGU), American Meteorological Society (AMS), and National Weather Association (NWA)[1], and encourages the Commission to delay further rulemaking until the National Oceanic and Atmospheric Administration (NOAA) study is complete. Filings in support of a terrestrial internet-based Content Delivery Network (CDN) as the sole data delivery service for geostationary weather satellite imagery and relayed environmental data are misguided[2]. The filing from AccuWeather presents a compelling and practical evaluation of the CDN constraints[3]; we provide further evidence. For detecting dangerous weather in the public interest, minutes and seconds matter.

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[1] *See* Letter from the American Geophysical Union, American Meteorological Society, and the National Weather Association, to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 19-116 (June 20, 2019).
[2] *See* Comments of Ligado Networks LLC, from Gerard J. Waldron, Ani Gevorkian, and Rafael Reyneri, WT Docket No. 19-116, RM-11681 (June 21, 2019).
[3] *See* Comments of AccuWeather, from Jonathan Porter, VP & GM, Business Services, WT Docket No. 19-116 (June 21, 2019).

This filing in WT Docket No. 19-116, responsive to the Notice of Proposed Rulemaking (NPRM) for sharing the 1675-1680 MHz band, underscores that, while a CDN does meet the needs of some users seeking an archive of weather data, other users, such as the SSEC, benefit from the timeliness and reliability of the satellite rebroadcast for the creation of environmental information products. This is because, by its design and as outlined in this filing, a CDN falls short of meeting strict timeliness requirements for weather forecasting, and is difficult to protect against all possible sources of interruption. Through an evaluation of CDNs containing weather satellite imagery that are open to examination, they miss the quality and reliability standards of a well-maintained satellite reception station.

SSEC's History in Weather Satellite Data Collection

The SSEC has a long history of receiving, ingesting, and processing meteorological data from geostationary satellites. That experience extends back to the 1960s with the first geostationary weather satellites, and continued into the 1970s with the Synchronous Meteorological Satellite (SMS) series and Geostationary Operational Environmental Satellite (GOES) series of satellites. The SSEC, in partnership with the NOAA, not only developed ingest and processing capabilities for these satellites, but significantly contributed to the calibration and validation of the data. SSEC was designated the official archive of all GOES data from 1979 until 2004, and continues to assist NOAA's National Centers for Environmental Information (NCEI) by providing archive satellite data to NOAA when their imagery is lost.

SSEC's leadership in satellite processing continues today through developing technologies and software for the real-time ingest and processing of GOES R-Series (GOES-R) ReBroadcast (GRB) data sent through the observing satellite. This software is called the Community Satellite Processing Package for Geostationary Data (CSPP-Geo). CSPP-Geo, was developed with NOAA funding and is used throughout North and South America. The NOAA National Weather Service (NWS) relies on CSPP-Geo for meteorologists to receive timely access to collected images, as do other respondents to this filing, such as Ligado, based on the declaration of Geoffrey Stearn.[4]

SSEC's Infrastructure and Costs

Much of the antenna infrastructure to support SSEC activities were first procured in the 1970s. Additions to the SSEC antenna infrastructure has continued in every decade since the 1970s. Due to the likelihood of interference with the GOES-R GRB feed as a result of terrestrial communications in 1675-1680 MHz and no proposed protection for Madison, Wisconsin, SSEC would be forced to move antennas into a geographic federal protection zone, a far less ideal solution because such an arrangement would still rely on internet connectivity to transmit the data to SSEC. Current estimates for replacement costs of two existing GRB antennas are approximately $130,000, not including the cost of the land where the antenna will be sited, site preparation, and internet connectivity fees. In the case of an auction, a new terrestrial operator in the 1675-1680 MHz band should responsibly cover such costs for the lifetime of the GOES-R Series program or agree to a protection zone and actively mitigate interference around Madison.

[4] *See* Written ex parte presentation from Gerard J. Waldron, counsel, Ligado Networks, to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 19-116 (June 13, 2019).

With increased internet bandwidth, the amount of satellite data available via terrestrial internet service has similarly increased significantly. Over the last five years, two international satellite programs, formerly transmitting data via satellite relay, have migrated to internet-only availability. In both cases, the number of outages and latency of data have increased. It is unwise for the Commission to position NOAA to make such a choice.

SSEC's Current Data Reception

SSEC receives Advanced Baseline Imager (ABI) data from both rebroadcast from the GOES-R Series satellites and an internet relay from NOAA's Product Distribution and Access (PDA) platform using NOAA SaTellite Applications and Research (STAR) office as an intermediary. SSEC has collected metrics comparing the number of files sent through each reception method.

The use of a terrestrial internet-based delivery method leads to increases in latency and missing files. For example, latency is often measured in minutes for internet-based delivery compared to 10 or less seconds for satellite delivery. The included table shows the number of image files from one of the GOES-R Series satellites, GOES-16, delivered via internet relay from PDA and Amazon compared to the same image files received via satellite rebroadcast. Amazon receives image files from the PDA through an institution in the Washington, DC, metropolitan area; the Amazon source does not receive access through STAR. While the period for the table is 60 days from 1 January 2019 through 1 March 2019, comparisons for other times are also available upon request from the Commission or interested parties.

day	ssec files	pda files	diff between DB and PDA via STAR internet	amazon files	diff between DB and internet from Amazon
1/1/19	52223	52223	0	52223	0
1/2/19	52224	52220	4	52220	4
1/3/19	52224	52223	1	52223	1
1/4/19	52174	52162	12	52162	12
1/5/19	52224	8453	43771	52218	6
1/6/19	52221	15383	36838	52221	0
1/7/19	52224	48321	3903	52208	16
1/8/19	52224	52222	2	52222	2
1/9/19	52224	52173	51	52177	47
1/10/19	52224	52223	1	52224	0
1/11/19	52218	52218	0	52218	0
1/12/19	52224	52224	0	52222	2
1/13/19	52224	52224	0	52224	0
1/14/19	52224	50997	1227	50958	1266
1/15/19	52224	52224	0	52224	0
1/16/19	52224	52224	0	52224	0
1/17/19	52224	52208	16	52208	16
1/18/19	52209	52208	1	52209	0
1/19/19	52224	52224	0	52224	0
1/20/19	52224	52224	0	52224	0
1/21/19	52224	52223	1	52223	1
1/22/19	52224	52224	0	52224	0
1/23/19	52160	52160	0	52160	0
1/24/19	52224	52224	0	52224	0
1/25/19	52160	52160	0	52160	0
1/26/19	52224	52224	0	52224	0
1/27/19	52224	52224	0	52224	0
1/28/19	52113	52044	69	52041	72
1/29/19	52223	52014	209	52005	218
1/30/19	52224	52216	8	52216	8
1/31/19	52224	52175	49	52186	38
2/1/19	51945	51945	0	51945	0
2/2/19	52224	52224	0	52224	0
2/3/19	52224	52224	0	52224	0
2/4/19	52224	52224	0	52224	0
2/5/19	52224	52224	0	52224	0
2/6/19	52224	52224	0	52224	0
2/7/19	52224	52224	0	52224	0
2/8/19	52288	52288	0	52288	0
2/9/19	52224	52224	0	52224	0
2/10/19	52224	52224	0	52224	0
2/11/19	52224	52224	0	52224	0
2/12/19	52224	52224	0	52224	0
2/13/19	52185	51501	684	51519	666
2/14/19	52224	50906	1318	51269	955
2/15/19	52224	52224	0	52224	0
2/16/19	52224	52033	191	52224	0
2/17/19	52224	52219	5	52219	5
2/18/19	52224	52199	25	52206	18
2/19/19	52512	52483	29	52489	23
2/20/19	52928	52928	0	52928	0
2/21/19	52992	52976	16	52976	16
2/22/19	52704	52704	0	52704	0
2/23/19	52160	52160	0	52160	0
2/24/19	52224	52224	0	52224	0
2/25/19	52224	43872	8352	43600	8624
2/26/19	52224	52030	194	52224	0
2/27/19	52224	52224	0	52224	0
2/28/19	52215	52215	0	52215	0
3/1/19	52224	52224	0	52224	0

Table Caption: This table shows the GOES-16 image file count comparison between SSEC, PDA, and Amazon between 1 January 2019 and 1 March 2019 (60 days). A file consists of a single image at a single time. Sixteen images are collected simultaneously because the GOES-R ABI has 16 spectral bands in the visible and infrared.

During the examined window, the number of files relayed via the internet, PDA or Amazon, never exceeded the number received using the rebroadcast service. When the ABI is operating in "Mode 3", which includes 30-second imaging of high-risk weather phenomena, there are a maximum of 52,224 image files in 24 hours. In "Mode 6", which includes two more full disk (hemispheric) scans per hour in addition to the 30-second imaging, there are a maximum of 52,992 files. On some days, NOAA runs the ABI in "Mode 3" for a portion of the day, and "Mode 6" for another portion.

Conclusion

Highly reliable, low latency GOES data are critical to support SSEC's research and support of operational activities, particularly for NOAA, including NOAA employees collocated with SSEC. Several experimental environmental information products for determining the initiation of severe storms and monitoring volcanic activity have low latency requirements. With the NWS using CSPP-Geo at high-visibility operational sites, a reliable GRB stream is also required to support the package and their operations. Finally, received satellite data are not only used for calibration and validation for newly launched satellites, but also to aid in satellite data broadcast problem troubleshooting.

SSEC asks the Commission to consider the interests of SSEC and similarly-situated institutions or organizations to preserve access to the satellite rebroadcast services (i.e., GRB) in and adjacent to 1675-1680 MHz. Should the Commission proceed with a terrestrial sharing arrangement despite the evidence-supported opposition, SSEC must be protected from any interruption to its geostationary weather satellite data collection as it exists today.

SSEC welcomes questions from the Commission directed to the undersigned.

Respectfully submitted,

R. Bradley Pierce

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